



Detection and Estimation of Metanil Yellow & Congo Red: Carcinogenic Food Colourants, Present in Different Food Samples

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ABSTRACT

Nowadays adulteration is a social disease which is applied on food to make food more attractive and to gain more profit from it. Along with different processed food products, Spices like Turmeric powder, red chilli powder, etc. provides good nutrition to us until they are treated with some foreign colours or organic colours to make them adulterated, which causes various detrimental effects in physiological system such as heart failure, liver damage, cancer and many more, if people consume them over a certain period of time. Metanil yellow, Sudan red dye, Congo red are such organic dyes which are used abundantly in different spices and processed food products. These dyes are toxic chemicals and could be carcinogenic as well. The presence of all these components can be detected with chemical experiments. This present research study is focused on the detection of adulterants present in sample on the basis of pH variation of adulterated food sample from the pure one and its estimation by variation of spectrophotometric absorbance with the concentration of the adulterant in the sample. After testing samples with different concentration of adulterants, it has been observed that pH of samples is gradually increasing with the increase in concentration of adulterants from 0 to 16.66 gm/ 100gm present in the sample.

KEYWORDS: Spectrophotometer, Metanil Yellow, Congo Red, pH, Colour Absorbance.

I. INTRODUCTION

Day by day the number of food adulteration cases are increasing rapidly and as a result it's became a concern for food safety organizations to trace adulteration in many food materials like honey, Spices, oils, dairy and meat products. [1] Many spices like Turmeric have a history of their

use for their medicinal value due to the presence of some chemical compound, (example - Curcumin for turmeric) [2] [3] [4]. For a customer to buy any food product, the first impression is governed mainly by its visual aspect than what impact it has on health after consuming it. Hence the use of synthetic food dyes forms an integral part in food

industries as an additive to hide the improper conditions of processing and to ensure uniformity and increase its attractiveness in order to achieve financial gain. [5] Metanil yellow, a non-permitted synthetic toxic azo dye, is reportedly used in the adulteration of some food items like in laddo, besan and more significantly in turmeric powder produced by the organized and unorganized sectors [6] [7] [8]. An estimate says that out of 253 food samples that are tested, 58 of them i.e., 20.94% of total samples contain metanil yellow in which 63.79% of the metanil yellow positive samples contained adulteration above the maximum permissible limit i.e., above the 100 mg kg⁻¹ food samples as specified in the Prevention of Food Adulteration Act of India (PFA, 2008). [9] Turmeric powder and red chilli powder has been evaluated with fourier transfer raman and fourier transfer infra-red spectroscopy to detect metanil yellow and congo red samples respectively in it at its lowest possible concentrations, it showed success at 1 and 5 % concentrations respectively. [10] The experimental values i.e., the absorbance values were observed from the Uv- Visible Spectrophotometer (Model: V-630). Metanil Yellow (MY) is a toxic and chief additive adulterant owing to its colour that ranges from yellow to orange and hence is majorly used in turmeric, pulses or sweets as per the colour requirement, in India. [11] Red chilli powder has a long history with congo red named hazardous azo dyederived from benzidine. which is used as adulterants and it has carcinogenic properties [12] [13] [14]. Congo Red has harmful effect even in low concentrations. The harmful effect of azo dye chemicals on human health have been documented. [15][16] Metanil yellow named azo dye is made from diazotized metanilic acid and diphenylamine. [17]

Hence colorimetric evaluation calls for a successful way to detect metanil yellow in food samples.[18] In our study we have utilised double slit UV visible spectrophotometer which uses two beams of light: a reference beam and a sampling beam that passes through the sample. A spectrophotometer can compare the brightness of incident lights by wavelengths. [19]

II. METHODOLOGY

In the process, double beam UV visible spectrophotometer was used. Pure metanil yellow solution and pure congo red solution was made, which was considered to correct the peak or for peak processing. Peak processing is done to achieve the highest peak or highest wavelength for

the pure sample known as the absorbance peak. Absorbance (on the vertical axis) is just a measure of the amount of light absorbed. The higher the value, the more of a particular wavelength is being absorbed. After peak processing the samples with different concentrations of metanil yellow and congo red were tested for their respective absorbencies with respect to the peak absorbance. It has been observed that the colour of pure turmeric powder solution will change to magenta colour with the addition of HCL in the presence of metanil yellow (Adulterant) and simultaneously pH of adulterated turmeric powder will vary with pure turmeric powder. And its pH and colour will vary the concentration of metanil yellow. And the colour of pure red chilli powder solution will change to deep purple colour with the addition of HCL in the presence of congo red dye (Adulterant) and simultaneously pH of adulterated red chilli powder will vary with pure red chilli powder. And its pH and colour will vary the concentration of congo red dye.

Spectrophotometric test:

II.1 Reagents Required

- Distilled Water - 30 ml (for each test tube)
- Hydrochloric Acid (35% concentration) - 4 drops
- Metanil Yellow
- Turmeric Powder
- Congo red dye
- Red chilli powder

II.2 Apparatus Required

- Uv- visible Spectrophotometer, V-630
- Test Tube (6 pcs)
- Dropper
- Digital pH meter'

II.3 Preparation of Samples

II.3.1 TURMERIC POWDER AND METANIL YELLOW

Sample 1: (Blank solution)

0 gm Metanil yellow + 3 gm Turmeric Powder + 30 ml Distilled Water + 4 drop Hydrochloric Acid

Sample 2:

0.1 gm Metanil yellow + 2.9 gm Turmeric Powder + 30 ml Distilled Water + 4 drop Hydrochloric Acid

III. Sample 3:

0.2 gm Metanil yellow + 2.8 gm Turmeric Powder + 30 ml Distilled Water + 4 drop Hydrochloric Acid

IV. Sample 4:

0.3 gm Metanil yellow + 2.7 gm Turmeric Powder + 30 ml Distilled Water + 4 drop Hydrochloric Acid

V. Sample 5:

0.4 gm Metanil yellow + 2.6 gm Turmeric Powder + 30 ml Distilled Water + 4 drop Hydrochloric Acid

VI. Sample 6:

0.5 gm Metanil yellow + 2.5 gm Turmeric Powder + 30 ml Distilled Water + 4 drop Hydrochloric Acid

II.3.2 RED CHILLI POWDER AND CONGO RED DYE

I. Sample 1: (Blank solution)

0 gm Congo red + 3 gm red chilli Powder + 30 ml Distilled Water + 4 drop Hydrochloric Acid

II. Sample 2:

0.1 gm Congo red + 2.9 gm red chilli Powder + 30 ml Distilled Water + 4 drop Hydrochloric Acid

III. Sample 3:

0.2 gm Congo red + 2.8 gm red chilli Powder + 30 ml Distilled Water + 4 drop Hydrochloric Acid

IV. Sample 4:

0.3 gm Metanil yellow + 2.7 gm red chilli Powder + 30 ml Distilled Water + 4 drop Hydrochloric Acid

V. Sample 5:

0.4 gm Congo red + 2.6 gm red chilli Powder + 30 ml Distilled Water + 4 drop Hydrochloric Acid

VI. Sample 6:

0.5 gm Congo red + 2.5 gm red chilli Powder + 30 ml Distilled Water + 4 drop Hydrochloric Acid

II.4 Procedure for spectrophotometric test [20]

I. Cuvette is placed into the Spectrophotometer by filling it with blank solution to calibrate Spectrophotometer.

II. After that, the reading of all sample with different concentrations are taken.

III. Same procedure is attained for Sample 3, Sample 4, Sample 5, Sample 6.

IV The wavelengths of the maximum absorbance value is recorded.

pH Test:

II.5 Reagents Required:

- Distilled Water - 30 ml
- Metanil Yellow
- Turmeric Powder
- Red chilli powder
- Congo red dye

II.6 Apparatus Required:

- Digital pH meter
- Beaker
- Glass rod

II.7 Sample Preparation

II.7.1 TURMERIC POWDER AND METANIL YELLOW

1. Sample 1: (Pure solution)

0 gm Metanil yellow + 3 gm Turmeric Powder + 30 ml Distilled Water

2. Sample 2:

0.1 gm Metanil yellow + 2.9 gm Turmeric Powder + 30 ml Distilled Water

3. Sample 3:

0.2 gm Metanil yellow + 2.8 gm Turmeric Powder
+ 30 ml Distilled Water

4. Sample 4:

0.3 gm Metanil yellow + 2.7 gm Turmeric Powder
+ 30 ml Distilled Water

5. Sample 5:

0.4 gm Metanil yellow + 2.6 gm Turmeric Powder
+ 30 ml Distilled Water

6. Sample 6:

0.5 gm Metanil yellow + 2.5 gm Turmeric Powder
+ 30 ml Distilled Water

II.7.2 RED CHILLI POWDER AND CONGO RED DYE

1. Sample 1: (Pure solution)

0 gm congo red + 3 gm Turmeric Powder + 30 ml
Distilled Water

2. Sample 2:

0.1 gm congo red + 2.9 gm red chilli Powder + 30
ml Distilled Water

3. Sample 3:

0.2 gm congo red + 2.8 gm red chilli Powder + 30
ml Distilled Water

4. Sample 4:

0.3 gm congo red + 2.7 gm red chilli Powder + 30
ml Distilled Water

5. Sample 5:

0.4 gm congo red + 2.6 gm red chilli Powder + 30
ml Distilled Water

6. Sample 6:

0.5 gm congo red + 2.5 gm red chilli Powder + 30
ml Distilled Water

II.8 Procedure for pH test:

I. Test Tube 1 is taken and pH is measured with
digital pH meter

II. Similarly, pH of test tube 2, test tube 3, test
tube 4, test tube 5, test tube 6 are measured and
the values are recorded.

III. RESULTS & DISCUSSION

The first table contains the data of the
concentration of adulterant i.e., Metanil Yellow
added in Turmeric Powder and its corresponding
pH. Similarly, the second table contains the data of
absorbance of the changed pink to magenta colour
from yellow colour on addition of HCL and the
concentration of Metanil Yellow added in Turmeric
Powder (**sample**). The third table is the data set of
Concentration of Congo Red in Red Chilli powder
and its corresponding pH values while on the other
hand the fourth table comprises the data of
absorbance of the changed blue colour on addition
of HCL reagent and the concentration of Congo Red
used in Red chilli powder (**sample**). The Total
amount of sample taken was 3gm (pure) and
gradually the adulterants were mixed in it
according to the concentration data given in the
following tables thereby maintaining a total weight
of 3gm (pure sample+ adulterant). The amount of
adulterants mixed in each of the pure samples are
calculated in terms of per 100gm of the sample as
shown below. The absorbance of all the samples is
measured at a particular wavelength.

IV. CALCULATIONS

In 3gm of pure sample= 0.1gm adulterant is
present

Therefore, in 100gm of pure sample=
 $(0.1 \times 100) / 3 = 3.33 \text{ gm} / 100 \text{ gm}$ of pure sample,
adulterant is present.

Similarly, the other data were calculated as
shown in the tables.

TABLE 1:

SAMPLE NO.	CONCENTRATION OF METANIL YELLOW IN TURMERIC POWDER (gm/100gm)	pH
1	0	6.7
2	3.33	7.26
3	6.66	7.65
4	10.0	7.96
5	13.33	8.35
6	16.66	8.7

TABLE 2:

The following data (absorbance) were observed in the wavelength of **515nm**.
Blank solution taken: 3.33gm of adulterated sample in 33.3ml Distilled water.

SAMPLE NO	ABSORBANCE (A)	CONCENTRATION OF METANIL YELLOW IN TURMERIC POWDER (gm/100gm)
1	3.1	3.33
2	4.4	6.66
3	4.5	10.00
4	4.6	13.33
5	4.78	16.66

CONCENTRATION OF METANIL YELLOW IN TURMERIC POWDER (gm/100gm) VS pH Graph

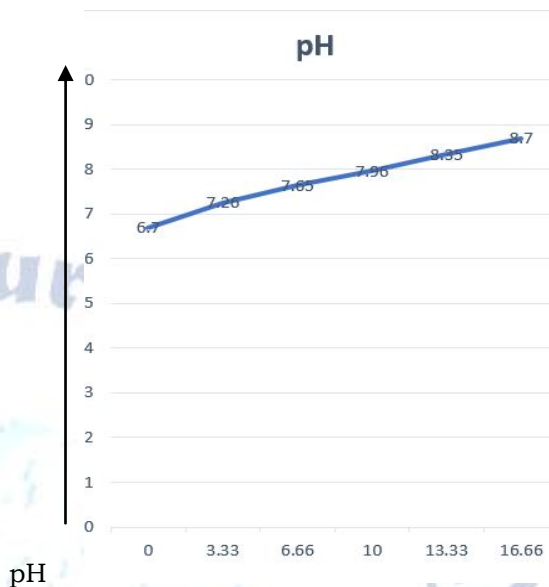


TABLE 3:

SAMPLE NO.	CONCENTRATION OF CONGO RED IN RED CHILLI POWDER (gm/100gm)	pH
1	0	4.88
2	3.33	5.04
3	6.66	5.17
4	10.0	5.44
5	13.33	5.76
6	16.66	5.98

CONCENTRATION OF METANIL YELLOW IN TURMERIC POWDER (gm/100gm) VS ABSORBANCE GRAPH

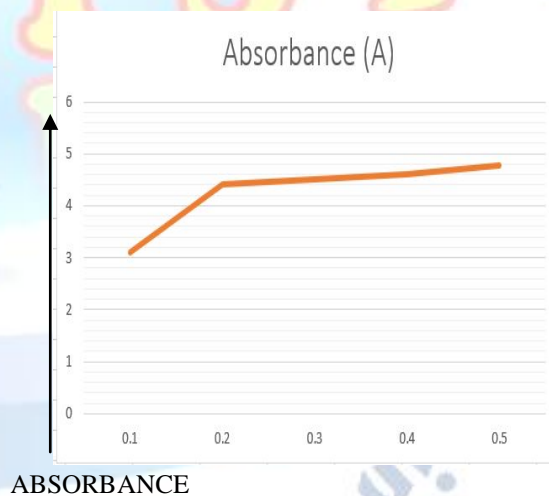
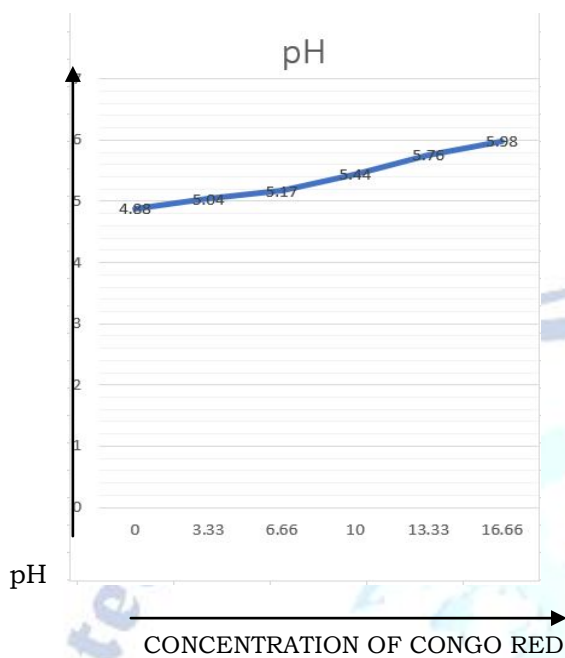


TABLE 4:

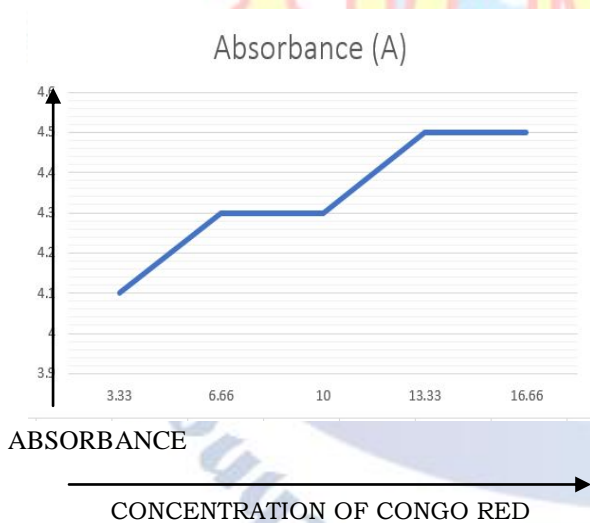
The following data (absorbance) were observed in the wavelength of **760nm**.
Blank solution taken: 3.33gm of adulterated sample in 33.3ml Distilled water.

SAMPLE NO	ABSORBANCE (A)	CONCENTRATION OF ADULTERANTS IN RED CHILLI POWDER (gm/100gm)
1	4.1	3.33
2	4.3	6.66
3	4.3	10.00
4	4.5	13.33
5	4.5	16.66

CONCENTRATION OF CONGO RED IN RED CHILLI POWDER (gm/100gm) VS pH Graph



CONCENTRATION OF CONGO RED IN RED CHILLI POWDER (gm/100gm) VS ABSORBANCE GRAPH



V. CONCLUSION

Undoubtedly Metanil Yellow and Congo Red are toxic, carcinogenic dyes which is used as an additive and food colorant. Its presence reduces the nutritional value of turmeric powder which is indeed a daily essential need. Despite of being known as a harmful food colorant, it is widely used in many food products as mentioned earlier and greatly affects human health. This research study shows how the value of colour absorbance and pH

of an adulterated sample varies with the concentration of Metanil Yellow added in pure turmeric powder and Congo Red in pure Red chilli powder. The aim of this research study is to make common people aware of the harmful adulterants that are being used in various food products that are being consumed on a daily basis. It is being clearly understood that how the pH and absorbance varies with the concentration of adulterants added in pure turmeric powder.

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